6. Contributions to our Knowledge of the Plankton of the Faeroe Channel[1].—No. VII. A. General Data of the Stations. B. The Protozoa. C. The Medusæ.

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(Plate LXVI.)

A.—GENERAL DATA OF THE STATIONS.

In the table now exhibited (see p. 1019) will be found the chief details of the successive collecting stations of H.M.S. 'Research' in the Faeroe Channel, 1896 and 1897: Stations 11[2] to 18 being in the "Cold Area," between July 30 and Aug. 6, 1896; Station 19 in the "Warm Area," Aug. 7, 1896; Station 20 in the "Cold Area," July 7, 1897.

The physical conditions of the Channel have been fully dealt with in the Reports of the various exploring expeditions[3] which have surveyed this classic district, of which it is not an exaggeration to say that the very beginnings of modern oceanography were made in its somewhat troubled waters.

Determination of the Horizons.

The horizons through which the Mesoplankton net remained open in 1896 were thus determined. In the first place, experimental hauls were made near the surface, to determine the number of fathoms through which the net must be towed at an approximately constant speed in order that the propeller (1) might open the net, (2) might shut it again. Of these experimental hauls, the contents of which were mostly not kept, the last one retained was 12*d*.

[1] Owing to the scanty leisure at my disposal, the series of papers under this title has been unavoidably disconnected.

The first three numbers dealt with some conspicuous and interesting species; the fourth, by Mr. I. C. Thompson, with the Copepoda; the fifth, by Mr. E. W. L. Holt, with the fish-larvæ; the sixth furnished a description of the special nets used for the Mesoplankton, and a short discussion of the general question of a midwater fauna. This and the future papers will discuss the organisms captured, group by group, and show their horizons by tables when necessary.

The references to previous papers of the series in the Society's Proceedings are:—No. I., 1896, p. 991; No. II., 1897, p. 523; No. III., 1897, p. 803; No. IV., 1898, p. 540; No. V., 1898, p. 550; No. VI., 1898, p. 567.

[2] Stations 1–10 were collecting-grounds in the neighbourhood of Kirkwall and do not concern the 'Research' cruises.

[3] C. Wyville Thomson: 'Depths of the Sea.' London, 1873, 8vo (H.M.S. 'Lightning' and 'Porcupine').—T. H. Tizard and J. Murray: "Exploration of the Faeroe Channel in 1880." Proc. Roy. Soc. Edinb. xi. p. 638 (H.M. hired ship 'Knight Errant').—T. H. Tizard: "Soundings and Temperatures obtained in the Faeroe Channel during the Summer of 1882." Proc. Roy. Soc. xxxv. p. 202 (H.M.S. 'Triton').

The procedure was then as follows:—The net and machinery, weighted up to 100 lbs., were lowered overboard, and a number of fathoms run out, slightly greater than that of the sounding in the case of the lowest horizon; the angle made by the line when taut was approximately measured, and a calculation made from Traverse Tables in the ordinary way as to the depth which the net had reached. As I have pointed out already [1], this, the usual method, is most fallacious; for the towing-line does not form the hypotenuse of a right-angled triangle (as presupposed by this method), but an unknown catenary, which is practically uncalculable except

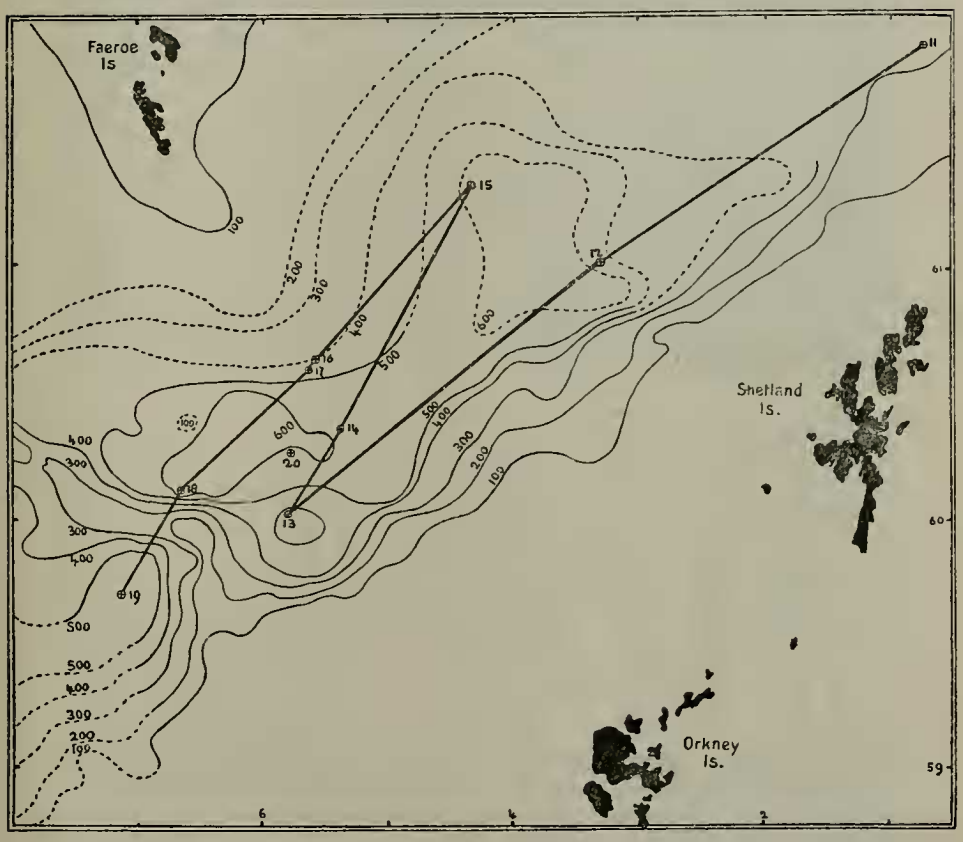

Chart of the Faeroe Channel,

Showing the collecting-stations of H.M.S. 'Research' in 1896 and 1897. The contour-lines have been roughly plotted from the Admiralty Chart and from the soundings taken on these cruises: they are dotted where the soundings are far apart. (Station 20 (1897) is N. of Station 13.)

by tedious experiment in order to obtain the necessary data. The fallaciousness of this method was brought home to me by striking bottom at 398 fathoms (Station 16 *a* i) with 450 fathoms of warp out, though by quadrant and traverse tables the net should only have reached 300 fathoms. Fortunately all the details of the previous hauls had been kept; and as there was sufficient evidence, from

[1] Proc. Zool. Soc. 1898, p. 568.

the condition of the paint and the small quantity of bottom-deposit in the collecting-tin, that the net had not more than touched bottom without dragging on it, I was able to get, from this accident, data for the correction of the other deep-water hauls. While, therefore, the horizons of the Mesoplankton hauls may perhaps be understated (if the net had rested long on the bottom in haul 16 *a* i), the depth is certainly not exaggerated.

That the calculation of the depth reached in this manner was a very close approximation to the truth, can fortunately be shown in another way. During the 1896 cruise, Captain Moore and the other Officers were engaged in taking serial temperatures[1]; and a minimum thermometer was sent down on the locking-gear of my net with every haul after 12 *e*. A comparison of the temperatures thus recorded on the net, and of the temperatures independently observed or interpolated on a curve by the Officers, is given below, where column I. shows the station number and haul letter; column II., the probable depth reached by the net (about 50 fathoms below the point at which it opened) as calculated from the data furnished by Station 16 *a* i when the net struck bottom; column III., the temperature recorded by the thermometer on the net, after correction; column IV., the temperatures for the depth given in column II., as independently observed or interpolated in the curves in Captain Moore's Report.

I.	II.	III.	IV.	
13 *a*	180	47·0	47·0	
13 *b*	356	32·6	33·0	
13 *d*	445	32·0	31·25	
13 *e*	445	32·0	31·25	
13 *g*	516	30·75	31·0	
15 *c*	578	31·0	30·75	
16 *a* i	400	30·6	30·9	at 380 fath.
16 *a* ii	356	31·0	31·5	
18 *b*	578	31·0	31·0	at 600 fath.
19 *a*	534	46·0	46·8	at 550 fath.

Considering the different times of day, and the slightly different positions owing to the ship's drift, at which the two sets of observations were made, their approximation is very close.

With the net of the 1897 pattern, which presented less resistant surface and less buoyancy than the other, no calculation of the depth was required: the line hanging vertically to the surface, the number of fathoms paid out indicated the depth sufficiently accurately. As to the rate of travel of the messengers, had time (*i.e.* weather) permitted, this would have been carefully worked into a curve: as it was, the impact could be felt at the less depths, and had to be guessed (good margin being allowed) for the greater depths. That the messengers travelled very rapidly was shown by the deep dints that they received on striking the locking-gear.

[1] W. U. Moore: Reports of Proceedings in connection with Investigations into the Physical Conditions of the Water of the Faeroe Channel.—Hydrographic Department, Admiralty, 1896, 4to.

Temperatures.

The temperatures given in the table are compiled from the readings of the thermometer on my net, and from the observations and interpolations published by Captain Moore (*op. cit. supra*).

Station Number and Haul Letter.	Position of ship.	Sounding in fathoms.	Horizon explored, in fathoms.	Temperature (Fahrenheit.) of horizon explored.	Meshes per inch.
11 *a* ...	61° N., 0° long.	203	100–±0	48°–54°	25
11 *b* ...	,, ,,	,,	0	54°	180
11 *c* ...	,, ,,	,,	30–0	49°–54°	36
12 *a* ...	61° N., 3° W.	502	±350–±150	31°–43°	25
12 *b* ...	,, ,,	,,	10–0	53°	36
12 *c* ...	,, ,,	,,	0	53°	180
12 *d* ...	,, ,,	,,	130–±0	44°–53°	25
12 *e* ...	,, ,,	,,	450–320	30°–32°	25
12 *f* ...	,, ,,	,,	?10–0	? 53°	? 36
13 *ab* ...	60° N., 5° W.	575	300–0	33°–54°	25
13 *c* ...	,, ,,	,,	2–0	54°	36
13 *d* ...	,, ,,	,,	400–270	32°–38°	25
13 *e* ...	,, ,,	,,	400–?	32°–?	25
13 *f* ..	,, ,,	,,	0	54°	180
13 *g* ...	,, ,,	558	465–335	31°–33°	25
13 *h* ...	,, ,,	,,	0	54°	180
13 *i* ...	,, ,,	,,	100–0	48°–54°	36
13 *k* ...	,, ,,	624	2–0	53°	36
13 *l* ...	,, ,,	,,	0	53°	180
14 ...	,, ,,	—	0	54°	180
15 *a* ...	61° N., 4° W.	610	2–0	53°	36
15 *b* ...	,, ,,	,,	0	53°	36
15 *c* ...	,, ,,	,,	530–0	31°–53°	25
15 *d* ...	,, ,,	,,	0	53°	13
16 *a* i ...	60° N., 5° W.	398	350–220	31°–37°	25
16 *a* ii...	,, ,,	,,	300–170	33°–44°	25
16 *b* ...	,, ,,	,,	0	53°	36
16 *c* ...	,, ,,	,,	4–0	53°	36
17 ...	,, ,,	—	0	53°	13
18 *a* ...	60° N., 6° W.	645	3–0	53°	36
18 *b* ...	,, ,,	,,	530–400	31°–?32°	25
19 *a* ...	59° N., 7° W.	595	480–350	46°–47°	25
19 *b* ...	,, ,,	,,	480–0	46°–54°	25
19 *c* ...	,, ,,	,,	4–0	54°	36
19 *d* ...	,, ,,	,,	10–0	54°	36
20 *a* ...	60° N., 5° W.	560	200–100	39°–46°	40
20 *b* ...	,, ,,	,,	300–200	33°–39°	40
20 *c* ...	,, ,,	,,	400–300	31°–33°	40
20 *d* ...	,, ,,	,,	500–400	30°–31°	40
20 *e* ...	,, ,,	,,	0	52°	36
20 *f* ...	,, ,,	,,	0	52°	180
20 *g* ...	,, ,,	,,	40–0	52°	36

Classification of the Hauls.

In the first table (p. 1019) the hauls are arranged in succession of number and letter, in order to facilitate reference; but in the subsequent tables of species they will be classified as Epiplankton (0 to $\pm$100 fathoms); Mesoplankton ($\pm$100 fathoms from surface to $\pm$100 fathoms from bottom); and "doubtful hauls," in which the net failed to shut at the expected horizon, or in which the contents of two hauls were accidentally mixed. On comparing these tables of species with that given in Mr. Thompson's paper on the Copepoda[1], it will be found that a few changes have been made. No. 12 *a* has been moved from among the "doubtful" to the Mesoplankton hauls, because it certainly closed somewhere near 100 fathoms, although perhaps not so low as 150; 12 *f* proves, by the character and condition of its contents, to have been made very near the surface, and has been put with the Epiplankton hauls; 13 *e*, about which I entered a note of suspicion in the station-book when it arrived inboard, proves to contain several essentially epiplanktonic organisms which do not occur in any other Mesoplankton haul, and has therefore been relegated to the "doubtful" category: in all probability one of the chains hung on the trigger for some time after the net should have completely closed; the details of this haul will be given later.

B.—THE PROTOZOA.

It was not to be expected that this group would yield much information with regard to the special object of the cruise, the Mesoplankton fauna. For the efficient study of the Protozoa, the nets must be extremely fine, so fine that they must be towed very slowly; and if they are towed slowly, a large part of the other constituents of the catch will escape. Special hauls with special nets, or a special arrangement inside the large mesoplankton net (which I hope to try shortly), are requisite for successful captures. On the other hand, some of my hauls show that certain Phæodaria live at great depths, although they do not show that any species are confined to the Mesoplankton.

As regards the surface Protozoa, no special attempt was made to collect them, for they were not required for comparison with the Mesoplankton fauna; and, further, my finest net, the only one suitable for Protozoa, was almost entirely devoted in 1896 to the capture by Dr. Stericker, R.N., of vegetable plankton for the Scottish Fishery Board. A few new and interesting forms of considerable size were, however, obtained.

Two things are apparent on a glance at the table of Protozoa—the one, the epiplanktonic character of the three Peripylaria; the other, the way in which several species are aggregated in the same haul, while other hauls show few or no Radiolaria. They seem to

[1] Proc. Zool. Soc. 1898, pp. 542–3.

appear and disappear together in accordance with varying external conditions.

Only those species appear in the table, the horizons of which seem to be in any way significant; the horizons of the rest will be simply recorded in the text.

Radiolaria Peripylaria.

Thalassicolla sp.

A number of specimens of this genus, taken chiefly at the surface, could not be assigned with certainty to any species already described. As with *Collozoum*, observations on living material seem to be necessary in order to determine the specific position. The following characters are enumerated here in order to assist future recorders in identifying the form from this locality:—The striated calymma is very thick and colourless, the alveolar layer internal to this is also very thick and colourless, with large alveoli; the extracapsular pigment is generally yellowish, occasionally dark in colour; the central capsule is dark and considerably thicker than in *T. nucleata*; in specimens of which sections were made, the membrane of the central capsule appeared to be divided up into numerous small polygonal areæ, with a single large pore in the centre of nearly every area; the nucleus is circular, with a thickish nuclear membrane and irregular nucleolus; intracapsular inclusions?

The proportion of central capsule to nucleus, often utilized as a specific character, does not appear to be trustworthy for this purpose. The table below gives this proportion in a number of specimens, apparently all referable to the same species: column I. shows the total diameter in millimetres, arranged in order of size; column II. shows the diameter of the central capsule expressed as a percentage of the total diameter.

I.	II.	I.	II.
3·38	29	1·27	38
3·29	19	1·26	33
2·10	40	1·23	28
1·96	21	1·11	33
1·96	21	1·09	32
1·90	30	1·09	32
1·75	22	1·07	21
1·70	22	·93	37
1·68	41	·92	30
1·61	21	·77	26
1·47	23	·63	36
1·44	22		

The proportions of striated calymma, alveolar layer, and central capsule showed similar variations.

It seems highly probable from the table that this *Thalassicolla* is

	Station Number and Haul Letter.	Horizon in fathoms.	*Thalassicolla* sp.	*Collozoum* sp.	*Siphonosphæra tizardi*, sp. n.	*Aulacantha laevissima* Hkl.	*Aulographis* sp.	*Aulographis moorensis*, sp. n.	*Auloceros trigeminus* Hkl.
Epiplankton.	11 *a*.	100-±0	...	...	...	...	...	...	...
	11 *b*.	0	+	+	+	...	...	...	...
	11 *c*.	30-0	+	+	...	...	...	...	...
	12 *b*.	10-0	...	...	...	...	...	...	...
	12 *c*	0	...	...	...	...	...	...	...
	12 *d*.	150-±0							
	12 *f*.	?10-0	...	...	...	...	...	...	...
	13 *c*.	2-0	...	+	..	...	...	...	...
	13 *d*.	0	...	...	...	...	...	...	...
	13 *h*.	0	...	...	+	...	...	...	...
	13 *i*.	100-0	+	+	+	+	...	...	...
	13 *k*.	2-0	+	+	+	...	...	...	...
	13 *l*.	0							
	14.	0	...	+	...	...	...	...	...
	15 *a*.	2-0							
	15 *b*.	0							
	15 *d*.	0							
	16 *b*.	0	+	+	...	...	...	...	...
	16 *c*.	4-0	...	+	...	...	...	...	...
	17.	0	+	...	...	...	...	...	...
	18 *a*.	3-0	+	+	+	...	...	...	...
	19 *c*.	4-0	...	...	+	...	...	...	...
	19 *d*.	10-0	...	...	...	...	...	...	...
	20 *e*.	0	...	...	...	...	...	...	...
	20 *f*.	0	...	...	...	...	...	...	...
	20 *g*.	40-0	...	...	...	...	...	...	...
Mesoplankton.	12 *a*.	±350-±150	...	...	...	...	...	...	...
	12 *e*.	450-320							
	13 *d*.	400-270							
	13 *g*.	465-335	+	...	...	+	...	...	+
	16 *a* i.	350-220							
	16 *a* ii.	300-170	...	...	...	...	...	...	...
	18 *b*.	530-400	...	...	...	...	...	...	...
	19 *a*.	480-350	...	...	...	+	+	+	+
	20 *a*.	200-100	...	...	...	...	...	...	...
	20 *b*.	300-200	...	...	...	...	...	...	...
	20 *c*.	400-300	...	...	...	...	...	...	...
	20 *d*.	500-400	+	...	...	...	...	...	...
Doubtful.	13 *a b*.	300-0	...	...	...	+	...	...	...
	13 *e*.	400-?	+	+	+	...	...	...	+
	15 *c*.	530-0	...	...	...	...	+		
	19 *b*.	480-0	...	+	+	+	...	...	...

Aulocoryne zetesios, gen. et sp. n.	*Aulosphæra flexuosa* Hkl.	*Cœlodendrum ramosissimum* Hkl.	*Cœloplegma murrayanum* Hkl.	*Lizzia blondina* Forbes.	*Sarsia* spp.	*Solmaris* sp.	*Solmundella* sp.	*Aglantha ? rosea* Forbes.	*Aglantha ? digitalis* O. F. M.	*Trachynema* sp.
...	...	...	...	...	...	+				
...	...	...	...	+	+	...	...	+		
...	...	...	+							
...	...	...	...	+						
...	...	...	...	+	+					
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...	...	...	...	...	...	+				
...	...	...	...	...	...	+				
...	...	...	...	+	...	+				
...	+	+	+	...	...	+	...	+		
...	...	...	+	..	...	+				
...	...	...	...	...	...	+				
...	...	...	...	+	+	...	...	?		
...	...	...	...	...	...	+				
...	...	...	...	...	...	+				
...	...	...	...	+	+	+				
...	...	...	...	...	...	...	...	+		
...	...	...	+	...		+	+			
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...	...	...	...	...	...	...	...	...	+	
?	+	...	+							
...	...	...	...	...	...	...	...	...	+	
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?	+	...	+	...	...	+	+	...	+	
...	...	...	+	...	...	...	...	...	...	+

an epiplanktonic form; it was plentiful at the surface, but in 13*g* and 20*d* only single specimens were captured, which were probably dead or dying and sinking to the bottom.

For the horizons of capture, see the table on p. 1022.

Collozoum spp.

Of this genus there were apparently two separate species represented in my collections, neither of which could be attributed to *Collozoum inerme* from the warm Atlantic, or to *C. ellipsoides*, described by Haeckel from the Faeroe Channel. In the one type the largest spherical zooids of the colony measured about ·05 to ·07 mm. in diameter, in the second type about ·09 to ·16 mm.; both had about ·2 to ·28 mm. of calymma and alveoli outside the zooids. In the first type there was a considerable thickness of alveolar calymma in the centre of the colony, as in the ordinary *C. inerme*; but in the spherical or lenticular colony of the second type the zooids were so closely aggregated in the centre of the colony as all but to touch one another, and were surrounded by a thick alveolar layer and a thick radiately striate calymma, exactly as a *Thalassicolla*.

Although I have no doubt that at least one undescribed species of *Collozoum* occurs in these waters, I do not feel justified in naming and describing it without a detailed examination of living material.

Both types were confined to the Epiplankton, except for a few specimens in haul 13*e*, which appears to have remained open through higher horizons than was intended or at first believed, and is now included with the doubtful hauls. As the *Collozoum* occurred in 30% of the Epiplankton hauls, and in no undoubted Mesoplankton haul, I think we are justified in regarding it as essentially epiplanktonic.

For the horizons of capture, see the table on p. 1022.

Lamproxanthium murrayanum, sp. n.[1]

Definition of the Species.—Spicules of the skeleton numerous, geminate-radiate, with a short axial rod, from each of which spring three or four acute shanks, devoid of branches or forks (sometimes three shanks at one end, four at the other). Both rod and shanks smooth and straight; shanks two to three times the length of the rod. Calymma full of large alveoli. Diameter of calymma 3·5 mm.; diameter of central capsule 1 mm.

This large and beautiful species is undoubtedly referable to Haeckel's genus *Lamproxanthium*; but I am unable to place it with certainty in any of his subgenera, and it agrees with none of his species. In addition to the geminate-radiate spicules there are

[1] I have great pleasure in dedicating this species to Sir John Murray, K.C.B., F.R.S., who is specially associated with the Faeroe Channel by his part in the exploration of the district in the 'Knight Errant' (1880) and 'Triton' (1882).

also a few which may be radiate, or may be only broken off from the end of a geminate-radiate spicule.

The horizon of capture was doubtful; one specimen was taken at 13 *e*, one at 13 *ab*.

Siphonosphæra (Holosiphonia) tizardi, sp. n.[1] (Plate LXVI. fig. 1.)

Definition of the Species.—Colony spherical (? always), up to about 2 mm. diameter. Zooids with a single spherical lattice-shell about ·15 mm. in diameter, which is beset all over by short broad tubes. The tubes are very thin-walled and fragile, their walls slightly convergent, ·010 to ·018 mm. in diameter, and about ·005 mm. high; there are five to seven tubes on the half meridian. Endosarc with very numerous nuclei; oil-globules?; zooxanthellæ very numerous, both inside and outside the shell, and also scattered through the calymma between the zooids.

In some hauls large numbers of the zooids had apparently broken away from the calymma, and appeared as solitary organisms referable to the family Liosphærida. As a warning to describers of Liosphærida, I may say that I had actually identified them as *Ethmosphæra leptosiphonia*, described by Haeckel from the Faeroe Channel, before I found them united in a colony.

So far as the evidence goes, the species is purely epiplanktonic; as it is a very conspicuous form, and it occurs with fair regularity at the surface (23 % of epiplankton hauls), and never with certainty in mesoplankton hauls, I think we are justified in accepting the evidence as fairly conclusive.

For the horizons of capture, see the table on p. 1022.

Radiolaria Acantharia.

Acanthometron catervatum Haeckel (=*A. brevispina* Hkl.) was present in most hauls with the fine-meshed net in 1896, often in sufficient quantity to give a red tinge to the contents of the tow-net. In 1897 (Station 20) it was practically absent from the surface, like most things. A similar abundance and scarcity were recorded by the 'Knight Errant' in 1880 in this district[2].

Radiolaria Phæodaria.

This interesting group of Radiolaria was well represented in the 'Research' collections, but not so well as in the 'Triton' collections made by Sir John Murray in 1882.

The data afforded by my captures show the extreme danger of drawing conclusions as to the vertical distribution of a species from a few observations at a single "station." I have already pointed out[3] that adequate data for this work can only be obtained

[1] I have pleasure in associating with this species the name of Captain T. H. Tizard, R.N., who explored the Faeroe Channel in command of the 'Knight Errant' (1880) and of H.M.S. 'Triton' (1882), to whom I am indebted for much valuable help.

[2] T. N. Tizard and J. Murray, Proc. Roy. Soc. Edinburgh, xi. p. 654.

[3] Proc. Zool. Soc. 1898, pp. 578–580.

by numerous observations at all depths on successive days in a small area, and even these cannot be safely applied to a species unless it occurs *constantly and in fair number in a large percentage of the hauls*. The table of Phæodarian captures given on pp. 1022–3 would seem at first sight to point to about 100 fathoms as the upper limit of all the species except *Cœloplegma murrayanum*; but the weakness of such an inference would lie in the fact that none of them were captured with anything like regularity in the Mesoplankton. That the argument would be false is shown by the fact that two of them were taken by Sir John Murray at the surface from H.M.S. 'Triton' in the same waters.

All the conclusions that can be drawn for the Faeroe Channel, from so few observations as those in the table, are:—

(1) That *Cœloplegma murrayanum* is both epiplanktonic and mesoplanktonic, extending to at least 350 fathoms (19 *a*) and a temperature of 33° Fahr. (13 *g*). The large number of specimens taken at 13 *g* and 19 *a*, and the small number taken at or near the surface, showed that the deep specimens were not merely dead and sinking to the bottom.

(2) That *Aulacantha lævissima* and *Aulosphæra flexuosa* may occur at considerable depths in the Mesoplankton; since the 'Triton' results showed them to exist at the surface also, they are, like *Cœloplegma murrayanum*, to be regarded as epiplanktonic and mesoplanktonic. Though not present in such numbers as the first species, they were plentiful enough to make it extremely improbable that the specimens were dead and sinking.

(3) That *Aulographis moorensis* and *Auloceros trigeminus*, var., occur in the Mesoplankton, but it does not appear whether they are confined to it or not.

Aulacantha lævissima Haeckel. (Plate LXVI. fig. 3.)

The youngest specimens referable to this genus in the 'Research' collections agreed entirely with Haeckel's description of *A. lævissima*, except for the presence of a few extremely minute teeth on the larger spines. Larger specimens, however, with a central capsule about ·4 mm. in diameter, and spines at least ·9 mm. in length and calymma about 2 mm. in total diameter, exhibited a distinct denticulation (Plate LXVI. fig. 3). As *A. lævissima* has been described only from the Faeroe Channel, it is probable that my specimens belong to the same species as those of Haeckel. I have therefore retained the name for "the smoothest" species described up to the present.

For the horizons of capture, see the table on p. 1022.

Aulographis (Aulographonium) moorensis[1], sp. n. (Plate LXVI. figs. 2, 4.)

Definition of the Species.—Radial tubes rounded proximately,

[1] With this new species I am glad to associate the name of Captain W. Usborne Moore, R.N., of H.M.S. 'Research,' to whose help I owe no small part of such success as my midwater experiments attained.

equally broad for most of their length, but then tapering slightly towards the distal end, at which the tube expands suddenly into a broad circular cushion. The margin of this cushion bears two verticils of radially divergent, slightly curved, terminal branches, about 10 to 16 in number; these are about twice as long as the inflated end of the tube is broad. Each branch is armed with two lateral rows of numerous recurved denticles, and bears a terminal spathilla of 5 to 8 recurved teeth (Plate LXVI. fig. 4).

One specimen: 480–350 fathoms, 46°–47° Fahr. (Station 19 *a*).

Aulocerus (Auloceræa) trigeminus Haeckel, Var. nov.

A few shattered specimens, of what is probably only a variety of the species above named, exhibited a verticil formed by the twice-repeated dichotomous branching of the radial tubes, each verticil thus consisting of eight tynes.

The type species is known only from the 'Challenger' Station 353, between St. Vincent and the Azores, at a probable depth of 2965 fathoms (open tow-nets).

For the horizons of capture, see the table on p. 1022.

Aulocoryne zetesios [1], gen. et sp. n. (Plate LXVI. figs. 5, 6).

Aulocoryne (Family Aulacanthida):—Radial tubes without lateral branches, terminating in a club-shaped expansion which carries numerous fine radiating spines.

Aulocoryne zetesios:—The spines of the terminal club are thin, tubular, at first straight or slightly curved, then regularly zigzag, lastly straight; they are finely denticulate, and terminate in a spathilla of about 8–10 recurved teeth (Plate LXVI. fig. 6).

A single specimen only of this species was captured. Although so broken that not a single head was left on the radial tubes, many heads had been fairly well preserved with the calymma, and there could be no doubt as to its structure. The fine spines of the terminal club are of the same character as the tangential spines of *Cannorhaphis spathillata* and the radial spines of *Cœlodrymus anchoratus*: the same types of growth recur again and again in the various families of Phæodaria, first as scattered spicules, then as tubes radiating from the central capsule, then bound together in a coherent skeleton.

Unfortunately, the exact record of the horizon was lost; it was captured in either 13 *e* or 13 *g*.

Cœlodendrum (Cœlodendridium) ramosissimum Haeckel.

This species was fairly plentiful at Station 13 *i*. It has been described as cosmopolitan, from various stations and depths, but not, I think, from so far north as the Faeroe Channel.

Cœloplegma murrayanum-tritonis Haeckel.

These species of Haeckel are the extremes of a series of very

[1] *αὐλός*, *κορύνη*, tubular club; *ζήτησις*, in honour of H.M.S. 'Research.'

varying forms, all terms of which were represented in the 'Research' collections. The range in depth is now extended to 480–350 fathoms; the lowest temperature to 31°–33° F. It has not been recorded except from the Faeroe Channel.

For the horizons of capture, see the table on pp. 1022–3.

Foraminifera.

Globigerina spp.

1. A very small species, probably a dwarfed *Gl. bulloides*, was fairly plentiful whenever the finest net was used at the surface. The specimens were spinous when captured[1].

2. On the occasion when the Mesoplankton net touched bottom, a very small quantity of bottom deposit was found in it, containing minute spineless Globigerinæ, which seemed to be referable to the species *G. bulloides* and *G. pachyderma*. It is very noticeable in balsam mounts of this sample that most of the supposed *G. pachyderma* are quite filled with what looks like brownish protoplasm, as are most of the bottom-living Foraminifera, but that most of the thin-shelled *G. bulloides* are clear and empty.—The brownish material, while yellowing slightly with nitric acid, does not give the brilliant tint of the usual xanthoproteic reaction. It would seem to be of a clayey nature, and is possibly, as Sir John Murray suggests, a stage in the formation of glauconite. It is extremely soft and friable, and when stained is almost indistinguishable from the similarly stained protoplasm of surface specimens.

The dependence of the formation of glauconite upon the presence of protoplasm has been pointed out in detail by Sir John Murray and the Abbé Renaud (Chall. Rep., Deep-Sea Deposits, pp. 385–390). If this material be of a glauconitic nature, its method of occurrence would seem to indicate that *G. pachyderma* on reaching the bottom contains more protoplasm than *G. bulloides*, and in that case probably lives nearer to the bottom. It is very desirable that voluminous samples of the bottom deposit should be taken in the Faeroe Channel in order to test this suggestion, and for the following reason.

The whole discussion as to whether *Globigerina* was a purely planktonic form, or could both float and creep at the bottom indifferently, would probably have been settled by the acceptance of the first alternative years ago, had it not been for an observation by Dr. Carpenter during the third cruise of the 'Porcupine'[2] which was recorded in his general discussion of the *Globigerina* question in 1875. This was to the effect that samples of water taken from immediately above the *Globigerina* ooze at 500–750 fathoms, in the Faeroe Channel, yielded on filtration "multitudes of young *Globigerinæ*," plentiful and small enough to make the water appear turbid.

The "cold area" of the Faeroe Channel is apparently the

[1] *Cf.* Brady: Proc. Roy. Soc. Edinburgh, xi. p. 717.
[2] W. B. Carpenter: Proc. Roy. Soc. xxiii. p. 235.

southernmost limit[1] for the occurrence of *G. pachyderma* in bottom deposits; it is abundant in Arctic deposits, but has never been recorded alive from the surface. *G. bulloides*, on the other hand, is only known to occur at the surface, although dead shells are plentiful in the deposits of the Faeroe Channel.

I venture to suggest that Dr. Carpenter's observation as to the presence of very small living *Globigerinæ* just above the bottom may be harmonized with the generally accepted view that most, if not all, *Globigerinæ* are essentially planktonic organisms, by the supposition that *G. pachyderma* is a mesoplanktonic form, at any rate in the Faeroe Channel. It is quite possible that it may occur at the surface farther north, but it would escape capture by any but the finest nets (diameter of the shell ·3 mm., according to Brady; my largest specimens were about ·15 to ·2 mm.).

Silicoflagellata.

Dictyocha sp.

A fair number of spicules referable to this genus of Ehrenberg occurred in one or two surface-hauls, notably 13 *h*. They agreed on the whole with the spicules of *D. stapedia* and *rhombus* (Haeckel), but no sign of the protoplasmic body was traceable. Prof. Cleve[2] records *D. fibula* and *D. speculum* (Ehrenberg) for the same cruise.

Dinoflagellata.

In reporting on the vegetable Plankton of the cruise of the 'Research' in 1896, Prof. Cleve[3] records the following species of Dinoflagellata:—

Ceratium tripos Duj.

Ceratium furca Duj.

Ceratium tripos Ehrenb.; var. *baltica* Schütt; var. *macroceros* Ehrenb. = var. *scotica* Schütt; var. *longipes* Bail. = var. *tergestina* Schütt; var. *horrida* Cleve.

Peridinium divergens Ehrenb.

Pyrophacus horologium Stein.

With the exception of the last, with which I did not meet, all these occur in all hauls with the finest net, many of them in great abundance.

Ciliata—Oligotricha.

Dictyocysta elegans Ehrenberg.

A beautiful species of this genus was fairly plentiful in some hauls, notably 13 *h*. According to Moebius[4] all the various forms of *Dictyocysta* are referable to Ehrenberg's species *elegans*, an

[1] H. B. Brady: Chall. Rep. Zool., ix. Foraminifera, p. 600 (*cf.* pp xii–xiv).

[2] 'Fifteenth Annual Report of Fishery Board for Scotland,' part iii. p. 302.

[3] P. T. Cleve: Fifteenth Annual Report of Fishery Board for Scotland, 1896, part iii. p. 297.

[4] O. Moebius: Fünfter Jahresbericht d. Commission z. wiss. Untersuch. d. deutschen Meere, 1887.

opinion which, I think, is not likely to be accepted by the next monographer of the group. My own specimens agreed exactly with Moebius's figure 28, pl. viii., and showed no signs of variation in the direction of other species. As regards the structure of the shell, I can confirm von Daday [1] as against previous observers in the belief that the neck (Aufsatz) consists of a meshwork, but that the body of the shell (Wohnfach), although appearing at first sight to be also a meshwork, is really a closed chamber. My specimens seem to show that the inner membrane of the "Wohnfach" is continuous everywhere except at the mouth, but that the outer membrane ceases at the so-called pores.

C.—THE MEDUSÆ.

My friend Mr. E. T. Browne has been kind enough to look over the few Medusæ of my collections. Of all groups this seems to suffer most in capture at sea. Near shore, or from an open boat, in fairly still water, the tow-net can be handled delicately; but on board ship in open water the characteristic sense-organs and delicate tentacles are broken by pressure against the tow-net, whether in the rolling of the ship or in the hauling of a meso-plankton net by steam-power from considerable depths.

In 1897 I tried to lessen the damage to surface forms, both by diminishing the net-mouth in proportion to the surface-area of the net, and by attaching the net-warp to a single-strap 'accumulator' of india-rubber; these certainly diminished, but did not avoid, damage. Only in a few cases was Mr. Browne able to assign a specific name; his list is as follows:—

1. *Lizzia blondina* Forbes.
2. *Phialidium* sp.
3. *Sarsia* sp.
4. *Sarsia gemmipara* Forbes.
5. *Solmaris* (possibly) two spp.
6. *Solmundella* sp.
7. *Aglantha rosea* Forbes.
8. *Aglantha digitalis* Haeckel.
9. *Trachynema* sp.

Of these the first five are probably purely epiplanktonic. *Lizzia blondina* was often present in such numbers as to tinge the contents of the tow-net.

Phialidium sp. (14) and *Sarsia* spp. (several hauls) presented no special features.

Solmaris sp. is almost certainly confined to the Epiplankton. A single specimen occurred in 20 *c* (400–300 fathoms); but as it occurred in 53 % of Epiplankton hauls, often in great profusion, and only a single specimen in one Mesoplankton haul, the presumption is that the latter specimen was dead and sinking to the bottom [2].

As to *Solmundella*, my captures do not afford any evidence of its vertical distribution.

[1] E. von Daday: Mittheil. zool. Station in Neapel, vii. p. 486.
[2] Compare Proc. Zool. Soc. 1898, p. 579.

What appeared to be broken specimens of *Aglantha rosea* of Forbes occurred in small numbers in three surface hauls.

The eighth species,

AGLANTHA DIGITALIS (O. F. Müller, Haeckel pars),

represents such of Haeckel's *A. digitalis* as remains after the restoration of Forbes's *A. rosea*, and the removal of *A. digitalis* var. *occidentalis* Maas [1]. In his great monograph Haeckel [2] put Forbes's *A. rosea* with eight marginal vesicles, and the old *A. digitalis* of O. F. Müller and Fabricius with four marginal vesicles, under the single species *A. digitalis*. Since then both species have been confused, until again separated by Browne [3]. It is consequently at present impossible to detail accurately the distribution of these two species, but it seems to be certain that *A. digitalis* occurs off Greenland and Northern Norway, and that *A. rosea* occurs as a neritic form round the British coasts (Valentia, Shetland, Heligoland). The one is certainly an Arctic form, the other a southern, even though they may overlap to a greater extent than we at present know.

This being so, it is not without significance that Mr. Browne, when going over my specimens without knowing the horizons, separated the *Aglanthæ* into two groups, *A. rosea* and *A. digitalis*, of which, on comparison with the station list, all the *A. rosea* were found to come from surface hauls, all the *A. digitalis* from deep hauls [4]. As *A. digitalis* was captured in 66 % of Mesoplankton hauls, and never at the surface, the presumption is that it has, like other Arctic surface forms, sunk to deeper strata on reaching lower latitudes (warmer surface water).

Unfortunately the results of the 'National' do not throw any further light on the distribution of these two species, horizontally and vertically, for Maas (*op. cit. supra*) accepted Haeckel's fusion.

TRACHYNEMA sp.

A few specimens of a large medusa were apparently referable to this genus. Hemispherical in shape (15 mm. diam., 12 mm. high), its eight radii showed the heavy transverse musculature of *Trachymedusæ*. The eight tentacles were stumpy and thick, one at the end of each radial canal. The sense-organs had disappeared. The manubrium was about 5 mm. long, devoid of a "Magenstiel," and provided with four very small oral lappets. What seemed to be rudiments of generative organs were placed on the upper third of the radial canals.

[1] O. Maas: Ergebnisse d. Plankton-Expedition. Die craspedote Medusen, p. 24.

[2] E. Haeckel: System der Medusen, i. p. 272.

[3] E. T. Browne: Proc. Zool. Soc. 1897, p. 833.

[4] One small specimen of *Aglantha*, too much damaged for reference to either species, was taken at 16*b*. In the table it has been placed as a query under *A. rosea*.

It is the only *Trachynema* which approaches *T. funerarium* Hkl. in size; but its proportions, and the position of the generative organs, are against its being a young form of this species. In most recognizable points it lies between *T. octonarium* Hkl. and *T. eurygaster* Hkl.; but it agrees exactly with neither. The eight radial canals and manubrium were of a strong brick-red.

It occurred in deep or doubtful hauls only.

EXPLANATION OF PLATE LXVI.

Fig. 1. *Siphonosphæra tizardi*, sp. n., p. 1025. A single individual is represented by half the shell and by half a section of the central capsule: outside the latter are zooxanthellæ. Cam. luc.

Fig. 2. *Aulographis moorensis*, sp. n., p. 1026. Termination of a radial tube. Cam. luc.

Fig. 3. *Aulacantha lævissima* Haeckel, p. 1026. Termination of a radial tube in optical section, showing the denticulations. Cam. luc.

Fig. 4. *Aulographis moorensis*, sp. n., p. 1026. A single terminal branch of a radial tube, showing the denticulations and spathilla. Cam. luc.

Fig. 5. *Aulocoryne zetesios*, gen. et sp. n., p. 1027. Termination of a radial tube, showing the club covered with zigzag spines. This beautiful drawing is due to the skill of Miss Mabel Green.

Fig. 6. *Aulocoryne zetesios*, gen. et sp. n., p. 1027. A single zigzag spine. Cam. luc.